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Eye and face protection for occupational use —

Part 1: General requirements

Protection des yeux et du visage à usage professionnel —

Partie 1: Exigences générales

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 94, *Personal safety — Personal protective equipment*, Subcommittee SC 6, *Eye and face protection*.

This document cancels and replaces ISO 4849:1981, ISO 4851:1979, ISO 4852:1978 and ISO 4846:1982.

A list of all parts in the ISO 16321 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This family of documents was developed in response to the worldwide stakeholders' demand for minimum requirements and test methods for eye and face protectors traded internationally. ISO 4007 gives the terms and definitions for all the various product types. The test methods are given in the ISO 18526 series, while the requirements for occupational eye and face protectors are given in the ISO 16321 series. Eye protectors for specific sports are mostly dealt with by the ISO 18527 series. A guidance document, ISO 19734, for the selection, use and maintenance of eye and face protectors is in preparation.

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Eye and face protection for occupational use —

Part 1: General requirements

1 Scope

This document specifies general requirements for eye and face protectors. These protectors are intended to provide protection for the eyes and faces of persons against one or more common occupational hazards such as impacts from flying particles and fragments, optical radiation, dusts, splashing liquids, molten metals, heat, flame, hot solids, harmful gases, vapours and aerosols.

Additional requirements for eye and face protectors used during welding and related techniques and for mesh protectors are given in ISO 16321-2 and ISO 16321-3, respectively.

This document applies to:

- all plano as well as corrective and prescription lens protectors and components;
- those eye and face protectors used for occupational-type tasks that are performed similarly to an occupation, e.g. "do-it-yourself";
- those eye and face protectors used in educational establishments.

This document does not apply to:

- protectors specifically intended for protection against only solar radiation and used in non-occupational environments for which the ISO 12312 series applies;
- protectors for medically prescribed applications (not occupational), e.g. eye protection for severe dry eye, tints prescribed for medical conditions;
- patient eye protectors during diagnosis or treatment (e.g. ISO/TR 22463);
- protectors for use during medical or e.g. aesthetic applications, e.g. intense light sources (ILS) for which the ISO 12609 series applies;
- protectors specifically intended for sports for which the ISO 18527 series applies;
- laser protectors;
- face protectors intended for live-working to protect against short-circuit electric arcs for which IEC 62819 applies;
- protectors intended to protect against ionizing radiation, e.g. X-rays, for which IEC 61331-3 applies.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4007, *Personal protective equipment — Eye and face protection — Vocabulary*

ISO/CIE 11664-1, *Colorimetry — Part 1: CIE standard colorimetric observers*

ISO 11664-2, *Colorimetry — Part 2: CIE standard illuminants*

ISO 12312-1:2013, *Eye and face protection — Sunglasses and related eyewear — Part 1: Sunglasses for general use*

ISO 16034:2002, *Ophthalmic optics — Specifications for single-vision ready-to-wear near-vision spectacles*

ISO 16321-2:—, *Eye and face protection for occupational use — Part 2: Additional requirements for protectors used during welding and related techniques*

ISO 16321-3:—, *Eye and face protection for occupational use — Part 3: Additional requirements for mesh protectors*

ISO 18526-1:2020, *Eye and face protection — Test methods — Part 1: Geometrical optical properties*

ISO 18526-2:2020, *Eye and face protection — Test methods — Part 2: Physical optical properties*

ISO 18526-3:2020, *Eye and face protection — Test methods — Part 3: Physical and mechanical properties*

ISO 18526-4, *Eye and face protection — Test methods — Part 4: Headforms*

ISO 21987:2017, *Ophthalmic optics — Mounted spectacle lenses*

ISO 80079-36:2016, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements*

3 Terms and definitions

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For the purposes of this document, the terms and definitions given in ISO 4007 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://standards.iteh.ai/catalog/standards/sist/9c22e3b5-dcfl-4f85-9d0f-3fd58860668/iso-ids-16321-1-2> <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 General requirements for protectors

4.1 Ambient temperatures

Protectors¹⁾ described in this document are intended for use at normal ambient temperatures (23 ± 5) °C. In order to ensure that critical aspects of protection are not compromised due to temperatures towards the extremes of the normal range of occupational environments from (-5 ± 2) °C to $(+55 \pm 2)$ °C, physical and mechanical requirements at extremes of temperature are included (sometimes optionally) in this document. These physical and mechanical requirements can also be provided by manufacturers for validation of claims for protection at temperatures below (-5 ± 2) °C and/or above $(+55 \pm 2)$ °C.

4.2 Physiological compatibility

Protectors shall be designed and manufactured in such a way that, when used under the conditions and for the purposes intended, they will not compromise the health or safety of the wearer. The risks posed by substances leaking or evaporating from the protector that can come into prolonged contact with the wearer, shall be reduced by the manufacturer to within the limits of any applicable regulatory requirement.

1) For the purposes of this document, “protector” is used as a general term for eye and/or face protectors such as, but not limited to, spectacles, goggles, face shields and eye shields.

Special attention shall be given to substances that are allergenic, carcinogenic, mutagenic or toxic to reproduction.

NOTE 1 Excessive pressure due to a poor fit on the head, chemical irritation and allergy are known to produce reactions. Rare or idiosyncratic reactions to any material are known to occur and the individual wearer is well advised to avoid those types of frame materials.

Substances recommended for cleaning, maintenance or disinfection shall be known to be unlikely to have any adverse effect upon the wearer, when applied in accordance with the instructions given in the information to be supplied by the manufacturer.

Manufacturers/suppliers shall perform an appropriate risk analysis on potentially harmful substances contained in the protector that, when the protector is used under the conditions and for the purposes intended, the health (and safety) of the wearer shall not be compromised.

The following are examples of documents that represent the appropriate information:

- a) specification of the material(s);
- b) safety data sheets relating to the materials;
- c) information relating to the suitability of the materials for use with food, in medical devices, or other relevant applications;
- d) information relating to toxicological, allergenic, carcinogenic, toxic to reproduction, or mutagenic investigations on the materials.

NOTE 2 Specific national regulations with regard to restriction of certain chemical substances need to be observed, for example release of nickel.

4.3 Construction and adjustment

Areas of the protector that may, during intended use, come into contact with the wearer shall be free from projections, sharp edges or other features likely to cause discomfort or injury during use.

Any part of the protector that can be adjusted or removed by the wearer for the purpose of replacement (in accordance with the instructions given in the information to be supplied by the manufacturer), shall facilitate adjustment, removal and attachment without the use of tools.

Any adjustment system incorporated in the protector shall maintain the intended fit for the foreseeable conditions of use.

The test shall be carried out by physical inspection in accordance with ISO 18526-3:2020, 6.1.

4.4 Cleaning and/or disinfection

The protectors shall be cleaned only once in accordance with the cleaning and/or disinfection procedures in the information to be supplied by the manufacturer before being subjected to testing.

4.5 Headform(s)

Unless the manufacturer specifies the headform(s) in accordance with ISO 18526-4 that is/are compatible with the protector, the test methods where (a) headform(s) is/are required shall use the headform 1-M in accordance with ISO 18526-4 as the default.

4.6 Mandatory and optional requirements

In this document both optional and mandatory requirements are described. Depending on the intended use and/or the manufacturer's claimed specification, some requirements marked as optional become mandatory.

5 Geometrical optical requirements for protectors

5.1 Field of view

Protectors, in the as-worn position, shall have a minimum unobstructed field of view in front of each eye of 30° temporally and nasally in the horizontal meridian, and 30° superiorly and inferiorly in the vertical meridian, when measured at the centre at the corneal apex of the headform in accordance with ISO 18526-3:2020, 6.2.

Protectors used for driving shall have a minimum unobstructed field of view in front of each eye of 60° temporally and 30° nasally in the horizontal meridian and 30° superiorly and inferiorly in the vertical meridian, when measured at the centre at the corneal apex of the headform in accordance with ISO 18526-3:2020, 6.2.

5.2 Refractive power and prismatic power for plano lenses

5.2.1 Spherical and cylindrical power

Plano lenses shall be tested at the reference points in the as-worn position in accordance with ISO 18526-1:2020, 6.1.

The spherical power and cylindrical power shall not exceed the tolerances given in [Table 1](#).

Table 1 — Spherical power, cylindrical power and prismatic power tolerances

Products	Spherical power Mean value of the focal powers (F_1, F_2) in the two principal meridians $(F_1 + F_2)/2$ dioptries (D)	Cylindrical power Absolute difference between the focal powers (F_1, F_2) in the two principal meridians $ F_1 - F_2 $ dioptries (D)	Additional requirements for mounted plano lenses, one-piece and visor covering both eyes Maximum difference between the measured spherical powers of the right and left lenses (F_R, F_L) $ F_R - F_L $ dioptries (D)	Prismatic power of unmounted plano lenses (in any direction) prism dioptries (Δ)
flat automatic welding filters, flat passive welding filters, cover, or backing plates for welding filters	$\pm 0,06$	$\leq 0,06$	$\leq 0,09$	$\leq 0,12$
eye shields, face shields, spectacles, goggles	$\pm 0,12$	$\leq 0,12$	$\leq 0,18$	$\leq 0,25$

5.2.2 Spatial deviation

If during the measurements in accordance with ISO 18526-1:2020, 6.1, a doubling or other aberration of the image is observed, then the plano lens shall be further assessed in accordance with ISO 18526-1:2020, [6.3](#). The plano lens shall be free from irregular distortions likely to impair vision.

5.2.3 Prismatic power for unmounted plano lenses covering one eye

Unmounted plano lenses shall be tested at the reference point in the as-worn position in accordance with ISO 18526-1:2020, 6.1.

The prismatic power shall not exceed the values given in [Table 1](#).

5.2.4 Prism imbalance of complete eye protectors or plano lenses covering both eyes

Complete eye protectors or plano lenses covering both eyes shall be tested in the as-worn position in accordance with ISO 18526-1:2020, 6.2. Depending on the interpupillary distance (PD) of the specified headforms, the respective diaphragm LB₂ shall be used.

The prism imbalance shall not exceed the values given in [Table 2](#).

Table 2 — Prism imbalance

Products	Horizontal		Vertical prism dioptres (Δ)
	Base out prism dioptres (Δ)	Base in prism dioptres (Δ)	
flat automatic welding filters, flat passive welding filters, cover, or back plates for welding filters	0,75	0,25	0,25
eye shields, face shields, spectacles, goggles	1,00	0,25	0,25

5.3 Mounted prescription lenses

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5.3.1 Optical

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The back vertex power, the direction of the cylinder axis, the addition power or the variation power, and the prism imbalance shall satisfy the requirements of ISO 21987:2017, 5.3.

5.3.2 Positioning

The positioning of multifocal lenses, of position-specific single-vision lenses and of power-variation lenses shall satisfy the requirements of ISO 21987:2017, 5.5.

5.4 Single-vision ready-to-wear near-vision lenses (lenses with positive spherical power)

The optical power range, the optical power, the design reference points and prismatic power shall satisfy the requirements of ISO 16034:2002, 4.2, 4.3, and 4.4.

5.5 Enhanced optical performance (optional requirement)

Enhanced optical performances for protectors with plano lenses may be claimed by the manufacturer if they fulfil the requirements given in both [Tables 3](#) and [4](#).

Table 3 — Enhanced optical performances — Spherical power and cylindrical power

Spherical power	Cylindrical power	Additional requirements for mounted plano lenses and one-piece lenses and visors that cover both eyes
Mean value of the focal powers (F_1, F_2) in the two principal meridians $(F_1 + F_2)/2$ dioptries (D)	Absolute difference between the focal powers (F_1, F_2) in the two principal meridians $ F_1 - F_2 $ dioptries (D)	Maximum difference between the measured spherical powers of the right and left lenses (F_R, F_L) $ F_R - F_L $ Dioptries (D)
$\pm 0,06$	$\leq 0,06$	$\leq 0,09$

Table 4 — Enhanced optical performance — Prismatic power and prism imbalance

Unmounted plano lens covering one eye	Mounted plano lenses, unmounted and mounted one-piece lenses and visors that cover both eyes		
Prismatic power prism dioptries (Δ)	Base out prism dioptries (Δ)	Prism imbalance Base in prism dioptries (Δ)	Vertical prism dioptries (Δ)
0,12	0,75	0,25	0,25

6 Physical optical requirements for protectors

6.1 Detection of signal lights

Detection of signal lights is a mandatory requirement for sunglare filters for occupational use, but an optional requirement for other protectors.

Between 475 nm and 650 nm, the spectral transmittance shall be not less than $0,20\tau_v$ and the relative visual attenuation coefficient, Q , for red, yellow, green and blue signal lights shall be not less than 0,80 when tested in accordance with ISO 18526-2:2020, Clause 11.

6.2 Luminous transmittance of lenses without deliberate filter action

The transmittance of lenses without deliberate filtering action (i.e. without declared scale numbers) shall have a luminous transmittance, τ_v , not less than 80 % when tested in accordance with ISO 18526-2:2020, 7.1, or ISO 18526-2:2020, 7.3.

For face shields with a lens thickness of more than 2,0 mm and for multiple glazed eye protectors, the luminous transmittance shall be not less than 75 %.

6.3 Specific requirements for different types of filter

6.3.1 Ultraviolet protective filters

6.3.1.1 General

Ultraviolet protective filters (UV filters) are intended to protect against the UV radiation that is emitted by radiators (lamps and lamp systems) exhibiting a high amount of short wavelength radiation. If greater reduction of glare in the visible spectrum is also required, this is taken into account with separate scale numbers (see also 6.3.1.2).

UV filters shall be tested in accordance with ISO 18526-2:2020, Clauses 6, 7.1, 7.3 and Clause 8, and classified in accordance with [Table 5](#).

6.3.1.2 Luminous and spectral transmittance and scale numbers

The luminous transmittance, as shown in [Table 5](#), is based on the spectral distribution for CIE standard illuminant A (see ISO 11664-2) and the CIE 1931 standard colorimetric observer (2°) (see ISO/CIE 11664-1). The scale number for the UV filter is determined by the value of its luminous transmittance in accordance with [Table 5](#).

Table 5 — Transmittance requirements for UV filters, code letter U

Scale number	Maximum spectral transmittance in the UV spectral range $\tau(\lambda)$			Luminous transmittance $\tau_{v,A}$	
	$200 \text{ nm} \leq \lambda \leq 313 \text{ nm}$ %	$313 \text{ nm} < \lambda \leq 365 \text{ nm}$ %	$365 \text{ nm} < \lambda \leq 400 \text{ nm}$ %	$380 \text{ nm} \leq \lambda \leq 780 \text{ nm}$ %	
U1,2	0,000-3	0,1	$\tau_{v,A}$	$100 > \tau_{v,A} \geq 74,4$	
U1,4				$74,4 > \tau_{v,A} \geq 58,1$	
U1,7				$58,1 > \tau_{v,A} \geq 43,2$	
U2				$43,2 > \tau_{v,A} \geq 29,1$	
U2,5				$29,1 > \tau_{v,A} \geq 17,8$	
U3				$17,8 > \tau_{v,A} \geq 8,5$	
U4				$8,5 > \tau_{v,A} \geq 3,2$	
U5				$3,2 > \tau_{v,A} \geq 1,2$	

NOTE UV filters protect the wearer against ultraviolet radiation whilst permitting any visual task to be performed safely and accurately. In particular it is necessary to take care that the colour of the filter permits any necessary perception of colour such as the detection of signal lights, markings and indicators and the evaluation of colour matches. UV filters that do not conform to these criteria could lead to difficulties for users. For further information about the selection of the correct protector, a guidance document (ISO 19734) for the selection, use and maintenance of eye and face protectors is in preparation.

6.3.1.3 Marking of UV filters

UV filters that meet the transmittance requirements given in [Table 5](#) shall be marked by code letter U. Filters that meet additionally the optional requirement for the detection of signal lights in accordance with [6.1](#) shall be marked by code letter UL.

6.3.2 Infrared protective filters

6.3.2.1 General

Infrared protective filters (IR filters) are intended to protect against the wavelengths of radiation from artificial sources that are longer than visible. If greater reduction of glare in the visible spectrum is also required, this is taken into account with separate scale numbers (see also [6.3.2.2](#)).

IR filters shall be tested in accordance with ISO 18526-2:2020, Clauses 6, 7.1, 7.3 and Clause 10, and classified in accordance with [Table 6](#).

6.3.2.2 Luminous and spectral transmittance and scale numbers

The scale number for the IR filter is defined based on the value of the luminous transmittance in [Table 6](#).